Original Article

Maternal Neonatal Outcome in Relation to Placental Location, Dimensions in Early Pregnancy

Shakuntala Chhabra, Yojna Yadav, D Srujana, Swati Tyagi, Imran Kutchi

Department of Obstetrics and Gynecology, Mahatma Gandhi Institute of Medical Sciences, Wardha, Maharashtra, India

ABSTRACT

Background: Placenta, which is the vital link between mother and fetus, is critical for maternal neonatal well-being. Its study in early pregnancy may provide information about maternal neonatal disorders. **Aim:** The study aimed to evaluate the relationship of placental location and dimensions in early pregnancy with maternal neonatal outcomes. **Subjects and Methods:** Primigravida (801) with singleton pregnancy at 10-weeks gestation and no past/present medical and obstetric disorder had ultrasonography for placental location and dimensions and were followed by ultrasonographic (USG) examination (at 20th week and 30th week), clinically for maternal-neonatal outcome. Statistical analysis was done by Epi 6 software (version 6.0, developed by Centres for Disease Control and Prevention, Atlanta, Georgia, USA) using Chi-square test and Fischer exact test for determining the statistical significance of the observations. *P* values of < 0.05 were considered as significant. **Results:** The number of primigravida with hypertensive disorders were 2.5% (5/200) with anterior, 20.5% (66/322) with fundal, and with posterior placenta 9.8% (12/123); Placental abruption 2.5% (5/200) with anterior, 6.8% (22/322) with fundal, and 3.3% (4/123) with posterior. With placental surface area <41 cm^2 19.0% (37/195), with area 41-55 cm^2 7.2% (30/416), and with area >55 cm^2 6.8% (13/190), had hypertensive disorders. area < 41 cm^2 11.3% (22/195), area 41-55 cm^2 5.0% (21/416), and area >55 cm^2 3.7% (7/190) had placental abruption. With thick placenta, 39.2% (58/148), thin, 9.4% (9/96), and normal placenta, 5.2% (29/562) had hypertensive disorders. With thick, 11.5% (17/148), thin 16.7% (16/96), and normal placenta 2.7% (15/562) had placental abruption. With anterior 0.5% (1/200), posterior 14.6% (18/123), fundal placenta 10.55% had preterm births. With anterior 7.5% (15/200), posterior 23.6% (29/123), fundal placenta 18% (58/322) had CS.With placental surface area <41 cm^2 28.7% (56/195), area 41-55 cm^2 14.2% (58/406), with > 55 cm^2 14% (28/200) had CS. With thin 27% (25/91), with thick 36.1% (53/148), with normal placenta none had CS for fetal distress. **Conclusions:** Study of placental location and dimensions in early pregnancy is useful in identifying risks.

KEY WORDS: Dimensions, early pregnancy, location, maternal-neonatal outcome, placenta

INTRODUCTION

Placenta, which is the vital link between the mother and the fetus for metabolic exchange, endocrine, and other body functions, is critical for maternal neonatal well-being. Therefore, ultrasonographic (USG) examination of placenta during pregnancy is a vital aid to pregnancy management. USG of placenta is primarily directed toward determining the location of the placenta and identifying its abnormalities in the later weeks of pregnancy. However, the advent of high-resolution transvaginal ultrasound (TVS) has revolutionized the understanding of placental studies, and it is believed that placental evaluation in early pregnancy could be useful in identifying the risks for subsequent disorders.[1-6] The site of implantation that decides the location of placenta is likely to be important determinant of placental blood flow and therefore pregnancy outcome.

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SUBJECTS AND METHODS

The present prospective study was conducted over 2 years at a rural referral institution in central India, after informed consent and ethical clearance from the local ethical committee. Study subjects, primigravida with singleton pregnancy, with no past or present medical or obstetric disorder at the time of inclusion, and who were willing for follow-up as specified, as well as planning to deliver at the place of study were included after written informed consent. They were registered in early gestation

Address for correspondence
Prof. Shakuntala Chhabra,
Department of Obstetrics and Gynecology, Mahatma Gandhi Institute of Medical Sciences, Sevagram - 442 102, Wardha, Maharashtra, India.
E-mail: chhabra_s@rediffmail.com

determined by the date of last menstruation. Body mass index (BMI) was calculated by using the formula of weight in kg/h (m^2) (height and weight were measured by using the height rod attached to the balanced beam scale), values taken were <20 kg/m^2 (low), 20-25 kg/m^2 (normal), and >25 kg/m^2 (high). USG was performed in the Radiology Department of the same institute by the radiologist on duty on the same USG machine to study placental location and dimensions. Women were followed-up with USG (at 20th and 30th week) to diagnose fetal growth restriction (FGR) or other abnormalities and clinically for maternal/neonatal outcome in terms of disorders like hypertensive disorders, gestational diabetes mellitus (GDM), placental abruption, cesarean sections, FGR, and preterm births. The findings on each visit were recorded on a predesigned proforma. Overall, 915 women were enrolled in the study, with 70 dropouts, 28 first trimester, and 16 second trimester abortions (analyzed separately); 801 study subjects were followed for maternal neonatal outcome. Statistical analysis was done by Epi 6 software (6.0, developed by Centres for Disease Control and Prevention, Atlanta, Georgia, USA) using Chi-square test and Fischer exact test for determining the statistical significance of the observations. *P* values of <0.05 were considered as significant.

Placental location was recorded and, according to major area of attachment, it was labeled as anterior, posterior, or fundal, irrespective of its extension to lateral side in anterior, posterior, and anterior or posterior in cases of fundal placenta and the area was measured by the maximum longitudinal dimension taken as the diameter of the placenta and the thickest part of the placenta, wherever it was (usually near the cord insertion), as the height. The placental thickness was calculated by taking the average of the three best measurements through the probe, oriented to scan perpendicular to the placenta. The placenta was labeled thin if the thickness was less than the tenth percentile, as normal if it was between the tenth and the ninetieth percentile, and as thick if it was more than the ninetieth percentile.[7]

RESULTS

Out of the 801 women, 200 (25%) had mainly anterior placenta, 123 (15.4%) posterior, in 322 (40.2%) major part was fundal, and, in the rest, placenta was in the lower part of the uterus, 129 (16.1%) Grade I, 9 (1.12%) Grade II, 6 (0.8%) Grade III, and 12 (1.5%) Grade IV placenta previa.[8,9]

Of the 78 women with BMI <20, 29 (37.2%) had anterior, 9 (11.5%) posterior, 28 (35.8%) fundal, and 12 (15.4%) had placenta covering the internal os; 14 (18%) had thick placenta, 16 (20.5%) thin, and 48 (61.5%) women had normal placenta; 29 (37.2%) had placental surface area <41 cm^2, 36 (46.2%) had 41-55 cm^2, and 13 (16.7%) had >55 cm^2.

Of the 665 women with BMI between 20 to 25, 158 (23.7%) had anterior, 105 (15.8%) had posterior, 267 (40.2%) had fundal placenta, and 6 (0.9%) had placenta covering the os; 124 (18.6%) had thick placenta, 72 (10.8%) thin placenta, and 469 (70.5%) had normal placenta; 156 (23.5%) had placental surface area <41 cm^2, 346 (52.0%) had 41-55 cm^2, and 163 (24.5%) >55 cm^2.

Of the 58 women with BMI >25, 13 (22.4%) had anterior, 9 (15.5%) posterior, 27 (46.6%) had fundal placenta, and 9 (15.5%) had low-lying placenta; 10 (17.2%) had thick placenta, 8 (13.8%) thin, and 40 (69.0%) had normal placenta [Table 1]; 12 (20.7%) had placental surface area <41 cm^2, 32 (55.2%) 41-55 cm^2, and 14 (24.1%) >55 cm^2 [Tables 1-3].

Table 1: Age, BMI and placental thickness

Age (yrs)	BMI	Placental Thickness					
		Thick		Thin		Normal	
		No.	%	No.	%	No.	%
≤19 (37)	<20	5	13.5	4	10.8	16	43.2
	20-25	4	10.8	1	2.7	1	2.7
	>25	4	10.8	2	5.4	0	0
20-29 (736)	<20	5	0.7	5	0.79	22	3.0
	20-25	116	15.8	66	9.0	470	63.9
	>25	6	0.81	6	0.8	40	4.1
>30 (28)	<20	4	14.3	7	25	10	35.7
	20-25	4	14.3	0	0	3	10.7
	>25	0	0	0	0	0	0
801		148	18.5	91	11.4	562	70.2

BMI – Body mass index

Table 2: Age, BMI, and placenta location

Age (yrs)	BMI	Placenta location									
		Anterior		Posterior		Fundal		Low lying (I and II)		Covering os (III and IV)	
		No.	%	No.	%	No.	%	No.	%	No.	%
≤19 (37)	<20	6	16	3	8.1	0	0	2	5.4	1	2.7
	20-25	8	21.6	5	13.5	0	0	4	10.8	5	13.5
	>25	0	0	1	2.7	1	2.7	1	2.7	0	0
20-29 (736)	<20	24	3.4	19	2.6	168	22.8	20	2.7	3	0.4
	20-25	124	16.8	81	11.0	124	16.8	107	14.5	2	0.3
	>25	18	2.4	10	1.4	25	3.4	4	0.5	7	1.0
>30 (28)	<20	3	10.7	3	10.7	3	10.7	0	0	0	0
	20-25	8	28.6	1	3.6	0	0	0	0	0	0
	>25	9	32.1	0	0	1	3.6	0	0	0	0
801		200	25.0	123	15.4	322	40.2	138	17.2	18	2.2

BMI – Body mass index

Table 3: Age, BMI and placental surface area

Age (yrs)	BMI	Placental surface area					
		41 cm^2		41-55 cm^2		>55 cm^2	
		No.	%	No.	%	No.	%
<19	<20	4	10.8	4	10.8	4	10.8
	20-25	4	10.8	4	10.8	4	10.8
	>25	6	16.2	7	18.9	0	0
20-29 (736)	<20	80	10.9	108	14.7	97	12.6
	20-25	70	9.1	141	18.3	40	5.2
	>25	23	3.0	134	17.4	43	5.6
>30 (28)	<20	3	10.7	5	17.9	3	10.7
	20-25	5	17.9	3	10.7	2	7.1
	>25	0	0	0	0	0	0
801		195	24.3	406	50.7	200	25.0

BMI – Body mass index

With anterior placenta, placental abruption occurred in 5 (2.5%), hypertensive disorders in 5 (2.5%), none of the babies of these women had FGR, 10 (5%) women had spontaneous preterm labor, and the rest 180 (90%) women had no abnormalities during pregnancy and labor. Of 322 women with fundal placenta, 66 (20.5%) had hypertensive disorders and 28 (42.4%) had FGR, 22 (7%) had placental abruption, 34 (10.6%) had preterm births, and 200 (62.1%) had no disorders. With posterior placenta, hypertensive disorders occurred in 12 (9.5%) (4 of these 12 had FGR also), placental abruption occurred in 4 (3.3%), 18 (14.6%) women had spontaneous preterm labor, and 85 (69.1%) had no abnormalities during pregnancy or birth [Figure 1].

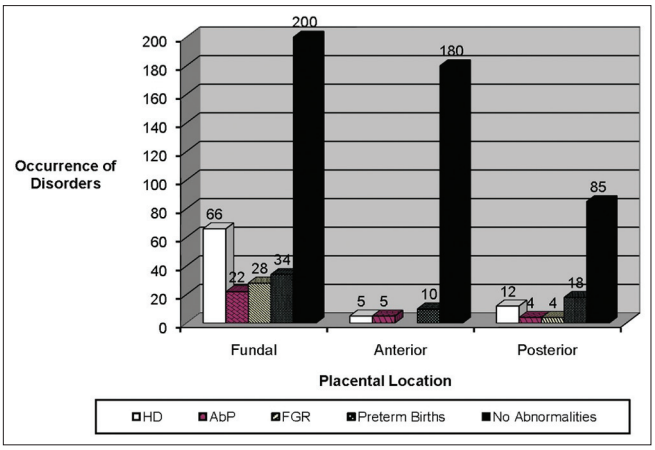

Figure 1: Placental location and disorders

Of 195 with area <41 cm^2, 37 (19.0%) had hypertensive disorder, and 22 (11.3%) had placental abruption; with area 41-55 cm^2, 30 (7.2%) had hypertensive disorders and 21 (5.0%) had placental abruption; with area >55 cm^2, 13 (6.8%) had hypertensive disorders and 7 (3.7%) had placental abruption [Figure 2].

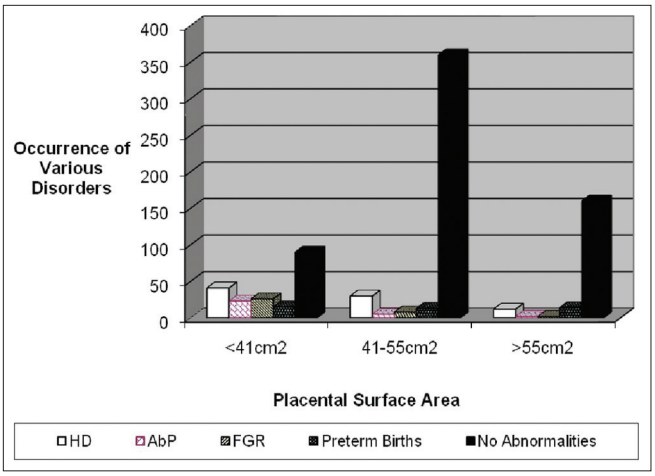

Figure 2: Placental surface area and disorders

Of the 148 women with thick placenta, 58 (39.2%) had hypertensive disorders [22 (38%) had FGR also], 17 (12.2%) had placental abruption, and 11 (7.4%) had GDM. Of the 96 women with thin placenta, 9 (9.4%) had hypertensive disorders [of whom 2 (22.2%) had FGR also], 16 (16.7%) had placental abruption, and 9 (9.4%) had GDM [Figure 3].

Of 801 women, 91 (11.46%) had preterm births, of 200 women with anterior placenta, 0.5% (1/200), with posterior placenta, 14.6% (18/123) and with fundal placenta, 10.6% (34/322) had preterm births; there was no significant difference among the three groups (P<0.001).

With placental surface area <41 cm^2 (195), 56 (28.7%), with area between 41-55 cm^2 (416), 59 (14.2%) and with area >55 cm^2 (190), 30 (15.8%) had cesarean births. CS rate was highest in women with <41 cm^2 placental surface area (P<0.001). Comparing the CS rate for fetal distress in cases of thin (27%) and thick placenta (36.1%), the difference was not statistically significant (P=0.16), but no woman with normal placenta had CS for fetal distress, and the difference was highly significant (P<0.001).

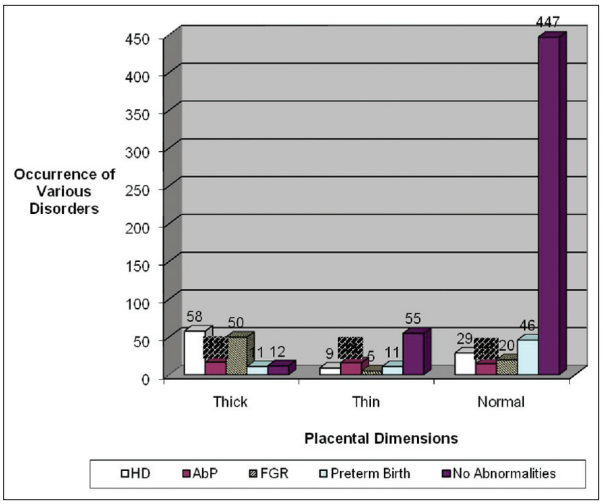

Figure 3: Placental dimensions and disorders

DISCUSSION

The birth of a healthy infant depends upon a coordinated series of events in the development of placenta and the fetus. Detailed analysis of gross placental structure can provide biologically relevant information regarding placental growth, development, and their potential consequences.[10] Over the years, USG has evolved as a safe noninvasive imaging technique for evaluation of fetal placental unit to detect and predict abnormalities, and it is being used for fetal well-being by many researchers. Kinare *et al*.,[11] reported that, in Indian mothers, mid-pregnancy placental volume is significantly associated with pre-pregnancy maternal weight, and it is an independent predictor of birth weight.

Thame *et al*.,[12] provided evidence that both placental volume and the rate of placental growth may influence fetal size. Researchers have also reported that these effects are evident in the first half of pregnancy, and appear to be medicated through maternal weight and weight gain; however, studies about the placental location, dimensions in early pregnancy, and the maternal neonatal outcome are lacking. In the present study, placental location and dimensions at early gestation were studied to know their correlation with pregnancy outcome. Placental location has been implicated in preterm birth, in fetal malposition, in malpresentation, and in the development of pre-eclampsia.[13,14]

In the present study of total 801 women, 78 with BMI <20, 30 (38.46%) of them had anterior placenta, 10 (12.82%) had posterior placenta, and 38 (48.71%) had fundal placenta. With BMI 20-25 (389), 29 (7.45%) had anterior placenta, 60 (15.42%) had posterior placenta, and 156 (40.10%) had fundal placenta; with BMI >25 (334), 140 (41.91%) had anterior placenta, 58 (17.36%) had posterior placenta, and 136 (40.71%) had fundal placenta. It was revealed that, with anterior placenta, only 2.5% had hypertensive disorders and none of the women with anterior placenta, who later developed hypertensive disorders, had FGR as compared to women with fundal placenta in whom, 66 (20.5%) women had hypertensive disorders and 28 of them had FGR also. Five women (2.5%) with anterior placenta in the first trimester had placental abruption, 22 (7%) with fundal placenta, and 4 (3.3%) with posterior placenta ($P=0.326$, not significant). Depending on major location, anterior, posterior, or fundal part of placenta was labeled as anterior, posterior, and fundal; however, some had part of placenta antero-lateral, postero-lateral, fundo-posterior, or fundo-anterior; this was not analyzed separately. It has also been reported by other researchers that fundal or cornual placenta are risk factor for utero placental apoplexy, causing placental abruption, which may lead to poor maternal-neonatal outcome.[15] In the present study, it was revealed that fetal distress occurred more often in women with posterior and fundal placenta as compared to anterior placenta ($P<0.001$), and, overall, there were more problems in cases of fundal placenta, followed by posterior as compared to anterior placenta. Kalanithi *et al*., have reported that pregnancy complicated by IUGR are significantly more likely than non-IUGR pregnancies to have a lateral placenta as compared with an anterior or posterior placenta at 16-20-weeks gestation.[16]

Earlier, Khan *et al*.,[17] reported that overall 8% cases of the low-lying placenta had growth retarded babies as compared to 6% of the normal ones. Corneau *et al*.,[18] found no difference in the gestation of babies between low lying and normally sited placenta. Joseph *et al*.,[19] reported a statistically significant low incidence of hypertensive disorders in placenta similar to earlier reports. In the present study, only one (8.3%) out of 12 women had placenta covering the os completely at term, had FGR and hypertensive disorders. There was no association with low-lying placenta. Whether placental migration occurs is debatable, and there are studies that reveal that migration does not occur in any patient with central placenta previa.[20] In the present study, migration issue of low-lying placenta was not studied in depth. However, in the final analysis, it was revealed that, for the major degree of placenta previa, there was no change in the location.

Hypertensive disorders occurred in 9.4% women with thin placenta as compared to 2.8% with normal placenta ($P<0.001$). Hypertensive disorders and vascular disease can have linkage to placental structure. It has been reported that thin placenta is often a marker for small for date fetus or a sign of growth restriction, intrauterine infection, and preconception diabetes mellitus.[21] In the past, Hoogland *et al*.,[1] revealed a "warning limit" of placental area at mid-pregnancy. If placental area was equal/smaller than with the limit of 187 cm^2, six of nine patients (67%) compared to four of 41 subjects with larger placentas ($P<0.01$) had delivered a small-for-gestational age baby. Recent study by Schwartz *et al*.,[22] revealed that two-dimensional placental measurements taken in mid-gestation are significantly correlated with the incidence of small for gestational age (SGA). Elchalal *et al*.,[23] reported that perinatal mortality is significantly higher, (6.8%) in sonographically revealed thick placenta than in normal (0.66%). These findings are in accordance with earlier study by Williams *et al.,*[24] however, in Wlliam's study, the placental thickness was measured in the second trimester. In a study by Luigi *et al*.,[25] where jelly-like thick placenta was diagnosed at early gestation and women were followed for the outcome, it was reported that hypertensive disorders and birth of SGA fetus occurred in 62.5% and 73% women, respectively. In the present study, SGA babies were 21.6% with thick placenta diagnosed in the first trimester, hypertensive disorders occurred in 39.2%, and, of these, 22 (38%) had FGR also. Thame *et al*.,[26] in their study of placental volume in the second trimester and infant size at birth reported that placental volume is a very strong determinant of birth weight. Hafner *et al*.,[27] reported that placental growth between 12 and 22 weeks is too heterogeneous to justify its use as a clinical tool, but authors mention that it can provide new information on placental physiology, underlying unfavorable outcomes. Burton and Jauniaux[28] reported that there are two broad categories of preeclampsia, maternal, and placental. In placental preeclampsia, the problem arises from the placenta that is under hypoxia with oxidative stress. Placental preeclampsia appears to progress in two stages: Preclinical, clinical, and other studies of placenta from early gestation can help.

In the present prospective study of selected primigravida,

USG was done around 10 weeks and maternal neonatal outcome was studied. The findings suggest that the first trimester USG could help in early identification of risk, as placental location and dimensions seem to affect pregnancy outcome. Hence, it is recommended to have more studies regarding early gestation placental location and dimensions and there is a need for establishment of standards for estimation of placental volume and associated overall pregnancy outcome.

STRENGTHS AND WEAKNESSES OF THE STUDY

Strengths of the study are inclusion of birth outcome in primigravida only, and the large numbers and follow-up until 1 week of birth.

Weaknesses of the study are lateral extent of placental location that are not included as well as details about possibility of placental migration. Also, only gross details included and intrinsic abnormalities of placenta were not included, but gross problems were automatically excluded.

CONCLUSION

Placental location and dimensions in early gestation seem to indicate possibilities of future problems. Anterior placenta seems to be safe and fundal placenta is very dangerous. However, more studies are needed with details of lateral extension and follow-up of cases including hypertensive disorders, abruption, growth retardation, and cesarean section for fetal distress.

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